CLAIMS

What is claimed is:

1. A method for treating an electrically conductive element in a fuel cell comprising:

providing a conductive corrosion-susceptible metal substrate having a surface susceptible to passivation by forming oxides in the presence of oxygen;

removing said oxides from said surface;

depositing an electrically conductive coating onto said surface, said coating comprising one or more elements selected from Groups 4, 5, 10, or 11 of the Periodic Table, having a corrosion-resistance greater than said metal substrate and having a thickness of less than about 50 microns; and

applying an electrically conductive corrosion-resistant polymer-based coating overlaying said coating comprising said one or more elements on said surface.

2. The method according to claim 1, wherein said metal substrate is selected from the group consisting of: aluminum, magnesium, titanium, alloys and mixtures thereof.

3. The method according to claim 1, wherein said metal substrate comprises aluminum.

4. The method according to claim 1, wherein said removing is conducted in a vacuum.

5. The method according to claim 1, wherein said removing is conducted by plasma cleaning.

6. The method according to claim 1, wherein said one or more elements are selected from Groups 4, 5, 10, or 11 is selected from the group consisting of: titanium (Ti), zirconium (Zr), vanadium (V), niobium (Nb), Tantalum (Ta), Gold (Au), Platinum (Pt) and mixtures and alloys thereof.

7. The method according to claim 1, wherein said wherein said one or more elements are selected from Groups 4 or 5 of the Periodic Table.

8. The method according to claim 1, wherein said one or more elements of said coating comprises titanium (Ti).

9. The method according to claim 8, wherein said coating comprising one or more elements comprises a compound selected from the group consisting of: titanium nitride (TiN), titanium suboxide (TiO_x, where $x<2$), and mixtures thereof.

10. The method according to claim 1, wherein said coating comprising one or more elements comprises one or more layers.

11. The method according to claim 1, wherein said coating comprising one or more elements has a thickness of between about 0.1 microns to about 50 microns.

12. The method according to claim 1, wherein said coating comprising one or more elements has a thickness of between about 0.5 microns to about 5 microns.

13. The method according to claim 1, wherein said applying of said polymer-based coating is conducted by a process selected from the group consisting of: coating, brushing, spraying, spreading, dipping, rolling, laminating, and powder coating.

14. A method according to claim 1, wherein before said applying, a matrix is formed comprising a polymer and conductive particles, and said matrix is applied to form said polymer-based coating.

15. A method according to claim 1, wherein said depositing of said coating comprising one or more elements is conducted by ion-assisted physical vapor deposition.

16. A method for treating an electrically conductive element in a fuel cell comprising:

providing a conductive corrosion-susceptible metal substrate having a surface susceptible to passivation by forming oxides in the presence of oxygen;

treating said substrate to remove said oxides from said surface;

depositing an electrically conductive titanium-based coating comprising titanium (Ti) onto said surface, wherein said treated and titanium-coated substrate has a greater corrosion-resistance and a greater electrical conductivity relative to an untreated and uncoated substrate; and

applying an electrically conductive corrosion-resistant polymer-based coating overlaying said titanium-based coating on said surface.

17. The method according to claim 16, wherein said titanium-based coating comprises suboxides of titanium.

18. The method according to claim 16, wherein said metal substrate is selected from the group consisting of: aluminum, magnesium, titanium, alloys and mixtures thereof.

19. The method according to claim 16, wherein said metal substrate comprises aluminum.

20. The method according to claim 16, wherein said treating is conducted in a vacuum.

21. The method according to claim 16, wherein said treating is conducted by plasma cleaning.

22. The method according to claim 16, wherein said titanium-based coating applied by said depositing comprises one or more layers.

23. The method according to claim 16, wherein said titanium-based coating has a thickness of between about 0.1 microns to about 50 microns.

24. The method according to claim 16, wherein said titanium-based coating has a thickness of between about 0.5 microns to about 5 microns.

25. The method according to claim 16, wherein said applying of said polymer-based coating is conducted by a process selected from the group consisting of: coating, brushing, spraying, spreading, dipping, rolling, laminating, and powder coating.

26. A method according to claim 16, wherein before said applying, a matrix is formed comprising a polymer and conductive particles, and said matrix is applied to form said polymer-based coating.

27. A method according to claim 16, wherein said depositing of said coating comprising titanium is conducted by ion-assisted physical vapor deposition.

28. An electrically conductive element for use in a fuel cell comprising:

an electrically conductive corrosion-susceptible metal substrate having a surface susceptible to passivation by forming oxides in the presence of oxygen; wherein said surface is substantially free of said oxides and overlaid with an electrically conductive corrosion-resistant coating comprising one or more elements selected from Groups 4, 5, 10, or 11 of the Periodic Table and having a thickness of less than 50 microns; and

a corrosion-resistant electrically conductive polymer-based coating applied over said titanium-based coating on said surface.

29. The electrically conductive element according to claim 28, wherein said metal substrate is selected from the group consisting of: aluminum, magnesium, titanium, alloys and mixtures thereof.

30. The electrically conductive element according to claim 28, wherein said metal substrate comprises aluminum.

31. The electrically conductive element according to claim 28, wherein said corrosion-resistant coating comprising one or more elements comprises one or more layers.

32. The electrically conductive element according to claim 28, wherein said one or more elements of said coating are selected from Groups 4, 5, 10, or 11 is selected from the group consisting of: titanium (Ti), zirconium (Zr), vanadium (V), niobium (Nb), Tantalum (Ta), Gold (Au), Platinum (Pt) and mixtures and alloys thereof.

33. The electrically conductive element according to claim 28, wherein said one or more elements of said coating are selected from Groups 4 or 5 of the Periodic Table.

34. The electrically conductive element according to claim 33, wherein said one or more elements of said coating comprises titanium (Ti).

35. The electrically conductive element according to claim 34, wherein said coating comprising one or more elements comprises a compound selected from the group consisting of: titanium nitride (TiN), titanium suboxide (TiO_x, where $x<2$), and mixtures thereof.

36. The electrically conductive element according to claim 28, wherein said corrosion-resistant coating comprising one or more elements has a thickness of between about 0.1 microns to about 50 microns.

37. The electrically conductive element according to claim 28, wherein said corrosion-resistant coating comprising one or more elements has a thickness of between about 0.5 microns to about 5 microns.

38. The electrically conductive element according to claim 28, wherein said substrate having said corrosion-resistant coating comprising one or more elements and said polymer-based coating has a contact resistance of less than 50 mOhm-cm^2 under a compressive force of 50 psi (350 kPa) or greater.

39. The electrically conductive element according to claim 38, wherein said substrate having said corrosion-resistant coating comprising one or more elements and said polymer-based coating has a contact resistance of less than 25 mOhm-cm^2 under a compressive force of 50 psi (350 kPa) or greater.

40. The electrically conductive element according to claim 28, wherein said polymer-based coating comprises a matrix of a polymeric binder and a plurality of electrically conductive particles.

41. The electrically conductive element according to claim 40, wherein said electrically conductive particles of said polymer-based coating are selected from the group consisting of: gold, platinum, nickel, tin, silver, palladium, noble metals, graphite, carbon black, and mixtures thereof.

42. The electrically conductive element according to claim 40, wherein said electrically conductive particles comprise graphite and carbon black.

43. The electrically conductive element according to claim 42, wherein said graphite is selected from the group consisting of: expanded graphite, graphite powder, graphite flakes, and mixtures thereof.

44. The electrically conductive element according to claim 42, wherein said total amount of graphite and carbon combined are present in said matrix at less than about 40% by weight.

45. The electrically conductive element according to claim 40, wherein said polymeric binder is selected from the group consisting of: poly vinyl esters, polyamide-imides, polyimides, polyether-imides, epoxies, silicones, polyphenols, fluoro-elastomers (e.g., polyvinylidene fluoride), polyesters, phenoxy-phenolics, epoxide-phenolics, acrylics, urethanes, and mixtures thereof.